Math

65

C

Comportment of Metallic

1st Group

Not precipitated from their solutions by HS, NH_4S, or Alkaline Carbonates.

Potassa.
Soda.
Ammonia.
Lithia.

2d Group

Not precipitated by HS. Are precipitated by NH_4S, under certain circumstances; and are by Alkaline carbonates.

Baryta.
Strontia.
Lime.
Magnesia.

3d Group

Not precipitated by SH; but as oxides by NH_4S.

Alumina.
Glucina.
Chromia.
Thorina.
Yttria.
Ceria
Zirconia
Titanic Acid.
Tantalic Acid.

Oxides with Reagents —

4th " Group —

Not precipitated from acid solutions by HS; but completely as sulphides by NH_4S.

Oxide of Zinc.
Nickel.
Cobalt.
Prot— " Manganese.
" & Sesq. Iron.
" Uranium.

5th " Group —

Completely precipitated from their solutions whether acid, alkaline, or neutral by HS.

Their sulphides insoluble in alkaline Hydrosulphides.

Oxide of Lead.
Silver.
-ides, Mercury.
-ide, Bismuth.
Cadmium.
Copper.
Palladium.
Osmium.
Sesq. of Rhodium.

6th " Group —

Completely precipitated from their acid solutions by HS; but not from alkaline — Their sulphides being soluble in alkaline sulphides.

Antimony.
Arsenic.
Tin.
Platinum.
Iridium.
Gold.
Selenium.
Tellurium.
Tungsten.
Vanadium.
Molybdenum.

Analysis of

1st Add HCL.

A – No precip. denotes absence of $\left\{ \begin{array}{l} AgO; Hg_2O; \\ \text{and } PbO \end{array} \right.$ –

B – A Precipitate – Add to this NH_4O –

a – If it dissolves it is Silver. Test this with $\left\{ \begin{array}{l} HS – \\ KO,CrO_3 \text{ – ruby} \end{array} \right.$

b – Turns black – Hg_2O – $\left\{ \begin{array}{l} \text{Test with } SnCl, \\ \text{and } Cu. \text{ (Metallic)} \end{array} \right.$

c – Undissolved – PbO $\left\{ \begin{array}{l} \text{Test with much water and} \\ \text{heat – It should dissolve.} \\ HO,SO_3 \text{ will give a dense} \\ \text{white precip. of } PbO,SO_3 \end{array} \right.$

(No precip. with HCl)

2o – Add to (1st) SH. Shake, heat, add a little more to make sure.

A – No precip. Absence of $\left\{ \begin{array}{l} PbO; AuO_3; PtO_2; HgO; \\ BiO_3; AsO_3 \text{ and } AsO_5; SnO; \\ SnO_2; SbO_3; CdO; CuO_3; Fe_2O_3 \end{array} \right.$ –

B – A precipitate is formed.

a – White $\left\{ \begin{array}{l} \text{caused by} \\ \text{free Sulph.} \end{array} \right\}$ – Fe_2O_3 $\left\{ \begin{array}{l} \text{Test with } K_2Cfy – \\ \text{and } NH_4O – \end{array} \right.$

b – Yellow – $\left\{ \begin{array}{l} CdO. \\ AsO_5, \\ AsO_3, \\ SnO_2, \end{array} \right.$ ‖ Add NH_4O, to make it alkaline Sulphide; and NH_4S,HS – It will be either

Solutions

b (continued)

α Undissolved CdO

β Dissolved either AsO_3; AsO_5 or SnO_2

Add NH_4O

1st white precip SnO_2

2nd no precip. With HS a precipitate (yellow) is immediately formed for AsO_3 but after some time by AsO_5

c Orange yellow SbO_3

d Brownish black SnO

ε Black PbO; HgO; BiO_3; AuO_3; PtO_2; CuO.

α Test with SO_3 white precip PbO

β $KO\,HO$ yellow HgO {Test with $SnCl$ and with Cu

γ NH_4HO blue CuO

δ BiO_3

ε FeO,SO_3 blackish AuO_3

ξ KCl & Alcohol {yellowish crystaline precip.} PtO_2

Analysis of

3rd.– Add NH_4Cl, and then NH_4 – finally NH_4S –

A – No Precipitate – absence of $\left\{\begin{array}{l} FeO;\ NiO;\ CoO;\ MnO; \\ Al_2O_3;\ Cr_2O_3;\ SiO_3;\ ZnO \end{array}\right.$ –

B – A precipitate –

a. – Black – Add NH_4

α – Greenish white precip. changing by exposure to the air FeO. Test with K_3Cfdy –

β – Pale green – NiO_3 – Add NH_4 – a precip dissolving in xs – then reprecip. by KO,HO –

γ – Blue to brownish red – CoO –

b. – Flesh color. MnO – Test with KO,HO –

c. – Bluish green – Cr_2O_3 – Confirm with KO,HO.

d – White – Al_2O_3; SiO_3; ZnO – Add KO,HO –

Solutions

4th Add NH_4Cl (As before to prevent a precip. of MgO) NH_4CO_2 and NH_4O

A No precip. Absence of BaO; SrO; CaO

B A precipitate Add $CaOSO_3$

a no precip. after a long time CaO

Test with $NH_4O, \bar{O}$

b very slight precip. after some time SrO

c dense heavy white precip. BaO Test with hydrofluosilicic acid

5th Add to (4) Phosphate of Soda. (stir it)

A No precip Absence of MgO

B Precipitate MgO

6th {May be NH_4O; KO; or NaO}

Add Lime-water Odor and test with $\bar{A}$. NH_4O

or add $PtCl_2$

A No precip NaO

B Yellow and crystaline precip KO

Test with $\bar{T}$

Detection of in simple substances

I. AsO_3 and AsO_5 –

AsO_3 { gives yellow color with Ammonio Nitrate of Silver
and green precip. in alkaline sol. with CuO,SO_3.

AsO_5 { gives red color with ammonio-nitrate of Silver.
and bluish green precip in alk. sol. with CuO,SO_3.

II. CO_2, HS, and CrO_3 –

CO_2 and HS { effervesce when HCl is added } { CO_2 makes a drop of lime-water turbid. HS – by odor and Lead-paper. –

CrO_3 is known by red or yellow color of solution.
Test by adding HS – (S liberated and Cr_2O_3 left with green color)
Test orig. sol. with $PbO,\bar{A}$ or AgO,NO_5 – which give a yellow color –

III. Acidify with HCl and $BaCl$ – or if AgO or HgO be present, with HO,NO_5 and add BaO,NO_5 –

A. No precipitate

B. White precip – HO,SO_3 –
Precip. insol in xs of HCl or HO,NO_5 –

Inorganic Acids soluble in water –

IV – Add CaO,SO_3 to slightly alkaline solution –

A – No precip – Absence of PO_5, $\bar{O}$, SiO_3 & F –

B – A precip – Ad $\bar{A}$ in xs to precipitate –

a – Dissolves – PO_5 or SiO_3 –

Add to orig. sol. NH_4Cl; MgO,SO_3 and NH_4O – a white precip – PO_5 –

b – Does not dissolve – $\bar{O}$ or F

Add to orig. sol. CaO,SO_3 –

α – white crystaline precip – $\bar{O}$ –

β – white flocculent precip – F –

$\bar{O}$ evolves CO_2 when heated with MnO_2 and SO_3.
F etches glass when heated with SO_3 –

V – Acidify with HO,NO_5 and add AgO,NO_5 –

A – No precip – Absence of Cl, Br, I, Cfy, Cfdy, and probably Cy –

B – A precipitate –

a – of a red color – Cfdy – Test with FeO,SO_3

(vide next page)

Detection of

(V – continued)

b – yellow-white – I, Cfy, Cl, Br or Cy.

Test orig sol with

α – Starch – blue – I –

β – $Fe_2O_3, 3SO_3$ (persulphate) – Cfy –

γ – Heating with MnO_2 and HO, SO_3

yellow tinge – Br –

δ – $Fe_2O_3, 3SO_3$, and NaO, CO_2 –

a precip. of Prussian blue – Cy –

ε – no indications above – Cl –

VI – Acidify with HCl and test with

Tumeric-paper – let the paper dry –

If brownish-red – Boracic Acid –

VII – HO, NO_5 gives brown stain in a

concentrated solution of FeO, SO_3 –

ClO_5 gives yellow tint to HO, SO_3 –

Acids

(V. continued)

b. yellow white. I, Cy, Cl, Br or Cy.

Test orig. sol. with

α. Starch. blue. I.

β. $Fe_2O_3\,3SO_3$ (persulphate). Cy

γ. Heating with MnO_2 and $HO\,SO_3$

yellow fumes. Br.

δ. $Fe_2O_3\,3SO_3$ and $NaO\,CO_2$.

a precip. of Prussian blue. Cy.

ε. no indications above. Cl.

VI. Acidify with HCl and test with Turmeric paper. let the paper dry. If brownish red. Boracic Acid.

VII. $HO\,NO_5$ gives brown stain in a concentrated solution of $FeO\,SO_3$.

ClO_5 gives yellow tint to $HO\,SO_3$.

Notes of Lectures
begun Mar 23, 1869 by Prof. [illegible]

[illegible]

The name of the science of [illegible] of
[illegible] and Anthropology [illegible]
In the little volume of Spencer [illegible]
begin at the beginning of biology. [illegible]
of [illegible]
Anthropology [illegible]
The earth [illegible] fitness for man [illegible]
[illegible] of geology, physical [illegible]
[illegible] of Natural History [illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible] which [illegible] the [illegible]
of life. [illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]

Notes of Lectures

begun Mar. 22, 1869, by Prof Hartshorne —

I.

{In connection with this Hartshorne's Medical Conspectus, Part Second —

We treat of the sciences of organic nature; of biology, and Anthropology at the culmination ~~initiative~~ of it.

In two late volumes of Spencer he scarcely gets beyond the beginning of Biology. It is the science of living beings opposed to inorganic things.

Anthropology, the whole science of man in relation to the earth. The earth was planned for man, and hence the interest of geography physical and descriptive; and also of Natural History, for its uses and analogies. Two important points in regard to Botany, 1 plants serve the uses of man — 2 their functions and structure resemble his.

This treatment of ours shall be of comparative biology, so to speak, which means the whole science of life. Comparative Anatomy includes the study of the organization of other animals with that of man. We cannot go over all the field. General physiology will most occupy us — man our great object. General physiology is the study of the most general relations of

materials, forces, & forms, of organised, living beings.

Organic matter defined. (Physy. p. 213)

We cannot omit the idea of purpose in these studies. Spencer has labored to do this, but I cannot. Owen comes out with confidence in it; and the Duke of Argyle in his Reign of Law brings out well the idea that every thing has purpose; the fact of adaptation to purpose being as clearly a scientific fact as any other; but we cannot know the last purpose, or final cause.

Physiology least of all the sciences can leave out the idea of purpose; it presents itself inevitably in the very method we pursue. Much presents itself to the Chemist that seems not. In many microscopic organisms we can not perceive the organs.

Organizable and post-organic matter (p. 213)

A German chemist Wöhler made a sensation about 30 years ago by announcing that he had made Urea; men thought that they could go on from one thing to another till they should make an animal. "Frankenstein" proceeds on this idea. Urea is cyanic acid with ammonia. Some fatty bodies have been

produced by synthesis — 15 or 20 or more substances; aromatic oils, fatty, &c. Leaving out a crystalline substance (claimed to be nerve matter tho this is never crystalline) no chemist has manufactured the substance of a living tissue. All that is done ends not in imitation of living man, but of the wearing out, dying man. Should they even make neurin & muscalin, they cannot endow it with life.

Protoplasm of Huxley —

Plants have excretions, waste, etc —
(See p. 219) — If a man were thoroughly dried like a mummy only one tenth would remain. No Chemist can make, as yet even, the coloring materials of the body. (pp. 215, 16) —

II.

More still about organic matter. One thing to be particularly noticed — the complexity of organic matter is a universal fact; but there are different degrees of complexity. The matter present in monads, (which consist of single cells,) and of in the lowest plants, is less complex than that found in organisms of higher developement; and there is a grade running up

thro' all lower plants to the dicotyledonous trees, and so on thro' lower & higher animals to man. Of all substances human blood is most complex. This view is interesting in connection with the theory of development — a word or idea not admitted by all. There is no question discussed so much at present as this. This fact of gradation is without refutation, both of the complexity of organizations from the simplest to the highest, and also of the conditions of nature. There was a period of fire and fluid, of lifeless sterility; a period when the matter for our nourishment either of animals or of vegetables existed not on the globe, because there were not in earlier geological times conditions for them. Will not discuss now the two opposite theories — of Agassiz, that every variety of species (as of butterflies with different spots on their wings) was the product of a special and immediate act of creation; — of Spencer & others (called Darwinian theory) that after an initiative act of special creation, all varieties are the result of evolution of an inward principle or law in what existed before. Owen says there is an innate tendency to deviate from the paternal

type. The nearest correct is probably a theory of "orderly creation, ~~with~~ in accordance, with conditions of increasing complexity themselves ordained by creative power. When the conditions of nature made the existence of higher beings possible, creation introduced them. The ancient notion of the origin of all things from an egg is a good type of the extreme theory of evolutive creation.

Owen denies "natural selection" and admits "derivation" — he ought to admit both.

Chemists and geologists have proved the orderly creation with increasing complexity.

Organic Forces — What we mean by force, is a difficult matter to agree upon. The subject as now treated is almost new. If there are any books (doubtless many) which treat of forces as imponderable substances they are out of date.

Heat is a mode of motion or movement, and causes vibrations in the (poorly named) universal ether. All force is a mode of motion, or cause of it. Vide p. 216.

The cause and effect in this case are hardly distinguishable, and in fact are not always distinguished in terms. Causality is present in a secondary sense. We say that heat burns, and that it makes a substance burn.

Nobody means by cause anything but secondary cause. There is an endless chain or series of causes all depending upon the First Cause. This carried the farthest by the Theistic philosophers. A good advocate of this is the Englishman Baden Powell in "The Unity of Worlds", tho his philosophy ~~theology~~ is in some parts very unsound. Secondary causations are forces. For cosmic forces vide Book p. 217.

III.

In speaking of life-force we must not suppose that every thing taking place in the living body, is a vital phenomenon. Old physicians did not admit that ordinary physical phenomena took place in the body at all; but the idea is not held now. Some even go so far as to say that there are but modifications of ordinary forces and changes of matter; a theory as erroneous as the other. There is much discussion yet about this theory. Lehmann, Vogt, Büchner and Moleschott say the human body is only a natural modification

of form, a crystal as it were. Rounded forms below.
Owen goes almost as far. The reasons in favor of special terms (nerve- and vital-force) are quite strong. Heat has its peculiar properties, so light, electricity, etc. We must have a name for each set of phenomena. If we rule out all the causes common to all nature, in the living body, we shall still have something unaccounted for, tho' all these exist. For instance digestion, suppose we St Martin's stomach to experiment with, we could with tubes heat, &c, make the same kind of digestion of food. So the heart a pump — a syringe will send the blood thro' the arteries in the same manner. So I have seen a pig pickled, the brine even coming out thro' his skin. Circulation a hydraulic mechanical process — respiration a physico chemical — so of others. Same things take place in plants as in animals. It is a property of organic matter to assume rounded forms; of inorganic, angular and flattened. This is a general distinction, with a few exceptions. Have heard a lecturer in the University

say that there is not a sharp edge in the body; only an approximation to it in a small ~~organ in the intestines~~ ligament at upper part of thigh.

The growth and change is by rounded cells or microscopic sacks. Ruling out all the cosmic forces, there is something unexplained; this Owen calls "formification" — the construction from a formless liquid of structures going thro' a series of forms. The now generally accepted name of this is vital force. It may hereafter be analysed as or into a "complex of forces."

Physicians used to think this a substance that existed in organic matter, and so old philosophers. Aristotle called this life substance the soul.

Porter, in his Human Intellect, leans to the theory that there is an identity between life and soul, and would resolve soul into force.

Some even now dispute the theory of vital force. Some are shocked at the idea of classing life with other forces, thinking that a kind of sacredness belongs to it. So have heard people say that thunder is the voice of God, and so deserving more reverence than other phenomena; but this is not a true way of regarding things. All things are the results or manner of God's action, and we ought not to

single out any one thing as really a more solemn action of God than any other. There is no peculiar sacredness to be attached to this force; it is correlated with the others. Faraday has done most to establish this. Grove, another Englishman, was almost the originator.

Thompson, about 1796, used the expression "heat is a mode of motion" in a letter. The fact was not fully established and proved concerning heat till Tyndall in our day. That motion can be practically converted to heat has long been known. Savages know it and practise it in building fires; cabmen in thrashing their hands; blacksmiths in pounding with their hammers – &c.

Heat is converted to light; also to electricity, as in the thermo-electric pile. Chemical force is turned into electricity, instance the battery. Electricity into chemical force, in decomposing HO, and in making HCl. This transmutation itself shows their correlation.

Life-force generates the others; in electrical fishes it is either life- or nerve-force that is chang-

ed, and in either case it is conversion: in glowworm firefly it changes to light (& without waste — ~~it products of~~ luminous rays)

Life-force is changed to heat, and conversely. Every egg must have heat to hatch it. We do not go as far as some philosophers. All the other forces are converted, and we may originate them at will; but not so vital-force. We cannot manufacture an animal, or renew the vital-force when once it has ceased to act entirely, tho' there is no perceptible difference immediately before and after.

John Hunter (Englishman) was struck with this fact more than fifty years ago. When a man is killed on the battlefield, he is all the same perceptibly as before, except a part of an inch it may be is changed. What is the difference.... Some maintain a theory of spontaneous generation; that living things spring into existence in purely inorganic matter. An Englishman named Crosse first experimented on this question. Also two Frenchmen; one, Pouchet, takes the affirmative.

An overwhelming majority of scientific men reject it; but Owen, very much to be wondered at, admits it. The opposing maxim "omne vivum ex vivo" was given by Harvey who discovered the

circulation of the blood. Bennett of Edinburg has assented to the other theory. Jeffreies Wyman made the experiments described last term, which disprove the theory, Pasteur kept organic liquid a year & a without infusoria — then let in air & they appeared.

Vide "Vital Force" p. 217. — Life force acts expansively from centres outwards. This is a venture of my own, suggested by noticing bubbles first globular and then assuming six-sided forms and others, by mutual compression. There is a question perhaps whether heat be not the expansive force, and life-force the modifying, shaping one.

Suspended in frogs, toads, alligators — etc — Also the seeds of plants — wheat — from the ruins of Pompeii, long buried, grown. Dr Hammond has thrown out the idea that if we knew how to live rightly we might live on forever; but forgetting the law of nature — the trees that live four thousand years die in their time.

"Life temperature" (a good term) is necessary to keep fibrin a liquid, just as heat keeps water so.

IV.

There two ways of looking at life-force; first the common sense view. How do we know that an animal is living? Suppose that at an artist should make a counterfeit, really perfect, of a plant for example. We might not distinguish, at first, but set them aside together for a week. One would be just the same, the other changed - fallen leaves, new buds, etc - No life without change, external and internal. Enamel of teeth does not change, and is the only part of the body that does not.

If we could have a microscope that magnified a thousand times more than the thousand times they do magnify, we might see growth formifaction as we do the hands of a watch in movement. "In the midst of life we are in death" true of us physically. The seven year notion is quite a mistake - some parts change more some less frequently. Life ascends to its height and then descends, has its wax and wane. Prof Cope has an idea that every species of life has a certain limited time to exist on the globe, with a law like that for

individuals. All life impulses are in time exhausted. Every thing that goes up must come down. Second— the philosopher's way.

One of Herbert Spencer's definitions of life, "the continuous adjustment of internal conditions to external conditions". He thinks this not quite adequate, (but the other has too many jawbreakers)— I think life is evolution in identity— Individual unity in progressive mutation. Evolution is the extending from simple organs out into special developements; it is not altogether peculiar to living beings; the globe is evolved from a molten mass and vapor; "identity" cannot with propriety at least in a similar sense be applied to a globe. There is great plausibility in the arguments holding that vital force is the result of many forces combined.

Those that maintain the exclusively teleological theory, say there must be divine power in what works for a purpose; so there is a sacredness in life-force.

If we can resolve life-force into a complexity of others, it will be no less wonderful, and philosoph-

ical to admit it. There is nothing in the power of selection and formation in the body that resembles the limitations of human skill. The working of this is shown in the processes of making Chromos, carpets, &c. Everything of the material world may be known before vitality is fully understood. There always was a simple form preceding a high one. It is probable that a similar idea to that of the heavenly motions will be reached in regard to the forces and particles of animated beings; & the converse as to purpose in astronomy & geonomy. See p. 218-19-20.

The liquids are not all of them present in all animals. Human blood most important of all, yet most difficult to understand. There are no nuclei in the red corpuscles of man. No corpusculated blood except in vertebrates. Human blood 10 or 20 times as complex as that of a worm. Oviparous animals have oval corpuscles in the blood. The serum left from coagulated blood is clear, contains albumen, salts, water. In some clots of healthy vigorous blood you may stick a knife and throw them across the room, some will hardly hold together.

Living blood will coagulate around little fibres. You can quicken boiling by putting little sticks etc in the bottom of a vessel. Blood will sometimes crystallize ^a number of days after death. There is about 15–20 lbs of blood in an adult. After bleeding, not a great difference in quantity in the bloodvessels, for water and other fluids of the system flow in as blood flows out; it is likely to be thinned in quality. Never found to contain pure gelatine. More fibrin in arterial blood. If air gets into the arteries, with blood, life is lost.

V.

Diameter of red corpuscles $\frac{1}{3300}$ of an inch; of white $\frac{1}{2500}$. A point of interest in the diameters is the comparison of human with other blood by adepts. The developement of blood is an obscure subject. vide p 220 – It is formed like tissues from primary cells; and that too before there are any heart and blood cells – first blood, then lacunae or cavities, afterwards blood ~~cells~~ vessels, and last of all

organs in the body, the heart. There are no primary cells after birth. Most physiologists think the colorless corpuscles originate in the chyle and are the young red ones, so to speak. This not established. Gray after having killed some eighty horses in the course of his experiments, thinks the spleen manufactures corpuscles when there are too few, and absorbs them when too many. I think this hardly probable. Some parts of the body would exist some little time in a state of pseudovitality, without blood. The total blood never escapes from its cells; it is in a closed system; it never meets all the organs. P. 221 —

When a person faints never allow him to be kept upright; lay him down. A physiologist in bleeding a patient once made him faint; he took him up by the heels and so poured blood into the head. In ~~dropsy~~ drowning what kills is the arrest of oxydation of the blood. Blood will not flow without oxygen. Compare Hooker Phys— on the chyle. The lymph goes into the blood thro' the thoracic duct also, except ~~in~~ that from the head

where it passes into a ~~vein~~ different vein. It passes thro' glands like the mesenteric. By "assimilation" fluids are made nearer like the tissues which they are to supply. The thymus and thyroid glands are not as large in adults as in infancy; the latter is swelled in the disease known in Switzerland and elsewhere as goitre.

There is something in the nature of the substances entering into living forms that gives a tendency to the rounded shape. Graham found that when a thin membrane was placed between two fluids, the salts passed thro' much quicker than albumen and its class. Those that pass thro' easily will crystalize; those substances like albumen which have least diffusive power differ most from crystalloids.

Herbert Spencer says that all colloids are more complicated than crystalloids. If so we must think the atoms are larger, and this may partly explain the difficulty of diffusion. Matter germinal, formed, and effete. P. 222. (Beale's theory) -

VI.

See p. 222. I think cells sometimes actually spring up in lifematter entirely free from other cells. Bubbles nearly always take a six-sided or polygonal form like cells. Afterwards other changes are effected and not always by compression, by formation, etc. Suppose many contiguous chambers to have the sides knocked out, we would have a tube; and if there were at the same time compression of the walls, fibres and filaments. Not all tubes from rows of cells. I saw in the case of a hospital patient a new formation of an artery formed in a clot, without cells, for a quarter inch in length. Spermatozoa were once thought to be animalcules, but are quickly moving cells. The power of cells to select, is a wonder for which no explanation has been given. A parallel is seen in chemical affinity. These are called ultimate facts, why O & H will not unite, Si & H &c –

Forrest see p. 224-5-6.

VII.

On Tissues –

Mostly in book pp. 226-7-8. Nobody has ~~observed~~ urged the definite existence connective tissue corpuscles but Virchow. The fibrous tissue is so strong that in powerful, sudden action of the muscles bone is broken, not tendon. A skater by a sudden movement snapped his knee cap in two. If the bone be removed or injured, but the periosteum remain there new bone formed more surely. A Philadelphian discovered the little muscle in the corner of the eye called tensor tarsi, which is in action in weeping. Fat is not a solid mass but really a liquid, mostly oil in cells. It gives beauty of contour – makes the difference in the consumptive, and in beauty between us and the fairer sex. The pain called pleurisy is caused by dragging or adhesion of the membranes composing the pleura upon each other making stitches of pain. In running the liver moving up and down drags or excites the peritoneum, causing sharp pain. The remedy of leaning over merely changes position of the organs. The arachnoid (middle membrane of those enclosing the brain) is so thin

that it has been disputed if it be a membrane, distinct in the body. —

XIII.

The term "glandular" is a doubtful one — all glands are alike however in having a multitude of peculiar cells; sometimes a little depression or pocket covered with cells, called a follicle. They may be folded up, or rounded out, in grape clusters, tangles, &c —

Glands act upon fluids taken from the blood, or upon blood itself, passing them thro' them.

The parenchymatous tissue is like packing tissue in its functions. in lungs, etc Only one kind of muscular was known before the microscope. The fibrils under the microscope look like strings of beads, and have been called muscle-cells; they are now called sarcous elements. (Meat.)

Experiments have proved that muscles do not change bulk in contracting. When the white fibre is touched, it moves more slowly, longer, and less suddenly, than the red. The heart tho' of voluntary or red muscle tissue is altogether involuntary; — perhaps this is because it is

necessary to have at the head of life-works a muscle that gives a quick response to the nerves or other excitement. So in action or emotion the heart pumps at once. The white tissue is in other places, as arteries, ducts, stomach, always to promote some slow continuous action, called peristaltic; this is a wavelike action, similar to that seen in a horse's neck when swallowing. Some few other muscles not fully voluntary as in throat, and those that express emotion in the face.

Gray nerve tissue is always in cells or vesicles, white in tubes. Gray is active, white like wires to batteries. You will not find them on ~~close~~ inspection regular tubes, — like strings more, & some as large as a lead pencil. They become hard by the hardening of fluid in them.

The study of morphology is very beautiful, and now very prominent. John Warner of Pottsville has given a very mathematical treatment of it, though not the first. Wolff & Göethe first discerned it. If we suppose matter

— Kaleidoscopic Top —

in form of lines or surfaces, it is held that we might by setting it in motion, produce all the various forms. The relations of forms of every variety are capable of mathematical expression. Pythagoras gave an equation for symmetrical beauty of form, called the "Golden Section"; If an object be divided into two unequal parts, the whole must have the same proportion to the greater part, as the greater part has to the less. The operation of forces in the germs of plants as they begin to grow is in spiral curves; often in many spirals; The spiral circles of trees are thought to be to each other as the series 1, 2, 3, 5, 8, 13 &c (each time adding the two last figures to make the next." An equation is even given for the curve of an egg.

Warner says Goethe has the honor of founding the science of morphology, or beginning of it. He discovered the principle that all the parts of the plant are modifications of the same form; the stamens pistils &c are the same with petals and leaves. Herbert Spencer credits him with indepen-

dent discovery, but says Wolff preceded him.

IX & X.

Reading from McCosh, Typical Forms and Special Ends in Creation. Order and purpose in creation familiar to the ancients. Plato thought that ideas had been in the mind of God from eternity, by and according to which all things are worked out. He recognized the τυπος and the τελος. M. thinks the former is well shown in Astronomy, and the latter better in Physiology. The Greeks embodied their ideas of beauty and order in the word κοσμος, as also the Latins in Mundus. Faraday came nearest right in his expression for "laws" that ~~they are~~ lines of force. I wish we could use other terms to express truth without confusion, and forget the word Law. In vertebrata there are only five digits in a limb, only seven vertebrae in neck. McCosh treats of "the geometry of nature" as a beautiful subject.

1872, P. 47 next.

Homology treats of the organs which are the same and have like relation in different animals. Analogous are those organs which are like in form or use but do not correspond in relation to the typical skeleton.

Read from Clark's "Mind in Nature" on morphology. An egg is bi-polar - albuminous and germinal. All animals bi-lateral in form originally. Wyman adds, with antero-posterior symmetry also. In some the form changes as the ~~fl~~ flat fish whose eye traverses even thro' other tissues, &c.

From Herbert Spencer. The shaping of the vertebrate skeleton has been a subject of much discussion among transcendental Physiologists.

When an elongated mass of ~~of~~ ~~fl~~ material is transversely strained it is subjected to a variety of forces. The lowest form of animals (fish and snakes) promote locomotion by a series of transverse movements, alternation of convexity and concavity.

The effect of this is to divide into segments.

The lancelet, lowest of vertebrates, has a vertebral column less subdivided - The vertebral

column, which at first was a cartilaginous rod, is disjointed much as a stick of sealing wax would be by bending back and forth.

From McCosh. The general order pervading nature is itself a final cause. He vindicates the idea of a final cause very carefully and conclusively.

Agassiz bases his knowledge wholly on science and observation of nature, independent of all men and books, and without asking questions of any but nature: and on such basis founds the doctrine of Creative power and special adaptations of organisms nature.

There are three modes of study with reference to gradation of contemporary types, stages of their growth (Embryology), succession in geological ages. Comparison of these shows them remarkably parallel. The products of physical agents are always the same; of organized beings present differences.

See Note Book D §6. Argument against the theory of "spontaneous" or "natural" as opposed to creative evolution.

XI.

The theory of upward aspiration as spoken of and caricatured by Prof. Ebell, is not the European Theory; but just now is hardly held by any one; it was the theory of Lamarck, and is the extreme opposite of Agassiz'.

Darwin (Charles M.A.) in the first page of his Origin of Species, quotes Whewell: Bridgewater Treatise; "But with regard to the material world, we can at least go as far as this — we can perceive that events are brought about not by insulated ~~fo~~ interpositions of Divine power, exerted in each particular case, but by the establishment of general laws." Bacon: Advancement of Learning; "Let no man out of a weak conceit of sobriety, or an ill applied moderation, think or maintain, that a man can search too far or be too well studied in the book of God's word, or in the book of God's works; divinity or philosophy; but rather let men endeavor an endless progress or proficience in both."

Butler: Analogy of R.R. "The only distinct meaning of the word 'natural' is stated, fixed, or settled; since what is natural as much requires and presupposes

an intelligent agent to render it so, i.e. to effect it continually or at stated times, as what is supernatural or miraculous does to affect it "for once."

This should seem sufficiently orthodox, and be taken to mitigate somewhat the charges against Darwin. But his own words farther on are more open to objection. He says (Page 399) "Nothing at first can appear more difficult to believe than that the more complex organs and instincts should have been perfected, not by means superior to, tho' analogous with human reason, but by the accumulation of innumerable slight variations, each good for the individual possessor." Yet this difficulty not real if we admit "that gradations in the perfection of any organ or instinct, which we may consider, either do now exist or could have existed, each good of its kind, — that all organs and instincts are, in ever so slight a degree, variable, and lastly, that there is a struggle for existence leading to the preservation of each profitable deviation of structure or instinct."

Darwinism is to be charged with more or less discouraging a belief in the creation

power of God. — The first fact he advances — a tendency to spontaneous variation; especially under domestication (a special example the pigeon.) 2. Accumulation of slight variations by natural selection, 3. the survival of the fittest in the struggle for existence. —

He says that Species are not immutable — that natural selection has been the main but not exclusive means of production and variation — Thus far, I think, it is and will be allowed by scientific men generally within twenty years. Prof. Cope believes it fully. But D. suggests continually much more. He only treats in full detail of variation of species, but passes inferentially to over that of types as if they had been varied in similar manner — which there is ~~nothing~~ not enough yet to prove. The existence of rudimentary organs is a strong argument for Darwinism. There are exceptions to the maxim (of Lamarck) natura non facit saltum — e.g. often in chemistry. Darwin is constantly speaking of "a powerful agent in nature ready to act and select" &c. — by which he

avoids coming out like Agassiz with the idea of the omnipresent God, which to an unprejudiced mind his argument leads to. vide Or. of Spe. p. 407 seq. 169 - al.

Baden Powell: The Unity of Worlds. The introduction of new species was a regular, not a casual not a solitary occurrence, - it is part of a series - Series implies regularity - if series regular the links must be so. "Tho' it is the attribute of Divine truth to be one and the same forever, it is no disparagement to that invariableness that natural theology should be <u>progressively</u> changing in the <u>aspect</u> and character of its <u>evidence</u>, with the improvement and advances of those sciences upon which it is founded; and thus leading us to <u>more enlarged and worthy conceptions</u> of the Infinite and Supreme Intelligence - - - - Thus to shrink from any investigation because it may seem to disparage hitherto accepted ideas, or to unsettle old convictions, is a mere mark of weakness and timidity which is inconsistent with the resolute pursuit of truth, and can end in nothing but endangering the very cause we seek

to serve, and yielding up the vantage ground to thy opponents." Id. p. 476 —

Owen's theory, of ~~ordained~~ derivation; pre-ordained succession of organic forms.

Natural science has come to be limited in the application of the term very much to the three divisions called the Statics viz — Structure, Classification, Distribution. There is a vast realm besides, of the Dynamics.

Agassiz on Classification — The divisions of animals according to branch, class, order &c not merely artificial — devices — they are based upon the natural, primitive relations of animal life; but translations into human language of the thoughts of the Creator.

Aristotle made the division, ζῶα ἔναιμα and ζῶα ἄναιμα. Linnaeus had six classes Mammalia, Aves, Amphibia, Pisces, Insecta, Vermes. Cuvier was first to report, in 1812, to the Academy of Sciences in Paris, as result of his investigations, four ~~classes~~ divisions, Vertebrata, Mollusca, Articulata, Radiata; which he called "embranchements" or branches.

Lamarck had Invertebrata, including "Apathetic" and "Sensitive" animal, and Vertebrata, including

"Intelligent" animals. "To say that neither Infusoria, nor Polypi, nor Radiata, nor Tunicata, nor Worms, feel, is certainly a very erroneous assertion".... "Modern investigations have shown that most of them have a nervous system, and many even organs of the senses". p 315. Ehrenberg discovered the properties of Infusoria. His classification presents many new views; (p 319); and there are many others. Owen has 1 Province - Vertebrata = Myelencephala. 2 Prov. Articulata = Homogangliata. 3 Prov. Mollusca. Sub. Prov. Radiaria. Sub. Prov. Entozoa. Sub. Prov. Infusoria.

Oken, - "the man who inspired every student who knew him with an ardent love for science, and with admiration for his teacher, - that man will never be forgotten" &c p 337 - "Man is considered, in this system, not only as the key of the whole animal kingdom, but also as the standard measure of the organization of animals." p 339.

Something taking in the idea that man is the standard of appreciation of all animal structures. But all attempts to apply it have proved failures. 340 -

"Archetype" is a word introduced by Maclise. He says ~~that~~ all other vertebral columns but man's are relative degenerations. (deprivations or short-stoppings)

XII.

Von Baer has done most to explain the general similarity of all animals in their embryology. His theory has been perverted into the idea that man passes thro all the conditions of fish, reptile, bird, mammal, &c; but it is true that some parts of growth are somewhat alike, and more so the nearer the beginning or first stages of developement. Man does not pass thro these conditions — his embryo never has gills or fins. Baer's classification is according to the manner of evolution —

Peripheric --- Evolutio radiata (proceeding from a centre)
Massive --- " contorta. (reminding us of phyllotaxis)
Longitudinal -- " gemina (arranged along a line or axis)
Doubly Symmetrical " bi-geminal (" " on the two sides & above & below)

Huxley especially values the idea of gradations. He is a Darwinian as far as Darwin himself goes — not to extremes. He has great central divisions from

which others branch out.

Vertebrata { Mammals
Birds
Amphibia
Pisces

Annulosa { Articulata
Annuloida

Mollusca { cephalopoda
pteropoda
&c

Protozoa { Rhizopoda
Gregorinidae
Sponges
Infusoria.

These are between the M. & the Protozoa, { Molluscoida
Brachiopoda
ascidioida
Ascida
approaching these latter

then
Hydrozoa —
~~Colentorata~~ Cœlentrata —

Comparison of forms is most easily followed in the skeleton — this belongs only to the vertebrate animals. There is a little piece of bone in the cuttle-fish; and in the slug a hard bit — but these cannot be called skeletons.

There is difference in the composition of bones, in the proportion of earthy and animal matter.

There is least mineral matter in those of fishes, and most in those of birds; more in salt water fishes than in fresh water, (because these need to be lighter). The porpoise (not a fish) has more, like man, &c. Frogs have more animal matter than larger land animals.

mineral matter
Serpents also have much in their bones.
Sturgeon has bone on outside; and so armadillo, but not gristle inside.

The vertebral column is not the special characteristic of vertebrates, but is an accident, or attendant, necessary for the brain and spinal marrow, or nervous system, which <u>is</u> characteristic. Sometimes bone is without sometimes within the other organs. Bullocks have bone in the heart; turkey leg-muscles contain them. Kangaroos have ossified marsupial sacs. These are the classes of skeletons.

1 Dermo-skeleton for surface
2 Neuro- " " nerve centres
3 Splanchno- " " internal organs
4 Sclero- " " tendons, ligaments, &c.

The ancient ganoid fishes had harder cases than the sturgeon. Only two species left; one in the Nile, and the lepidostris in the Ohio. In no species are the bones a primary formation; always for and from some thing else. Their mineral constituents are

in albumen, milk, blood. Sometimes they are formed in cartilage, sometimes in membrane. In fishes bones grow all thro' life. Some of frogs' bones and others have a shaft between two ends. In human frame growth goes on till fifteen; and even after thirty by means of the periosteum. No growth in adults but repair. Most fish bones are spongy in the interior; heavy and sluggish animals have solid bones. All bones are first solid and then become hollow afterwards. The bones become hollow for lightness and strength (as the straw). The osseous tissue in active animals and birds is more firm but less in quantity. The ends are more spongy than the middle. The enormous beak of the hornbill is really a large air cell, very light. In all flying birds the air is warm and lighter than the exterior. The apteryx of New Zealand and the Penguin have not hollow bones. There are not many cavities in bones of mammals; tho'

50

some—as the sinuses, which in other animals than man are sometimes quite large—in beeves they extend into the horns—in the Elephant and the owl they give a wise, intelligent look not deserved by their brain. The sclerotic coat of the eye in man is a membrane, in the turtle it is cartilaginous, in many fishes bone.

The lancelet (amphioxus) never has any bones. All lung breathing vertebrates have.—(The structure and names of the "ideal skeleton" of Owen omitted, except the neurapophyses centrum haemapophyses & the ribs are the pleurapophyses.) Oken in walking one day met a skull and was struck with the idea that it was a vertebra. Maclise pushes not the vertebral structure so far as Owen does. The limbs are as much archetypal as the back-bone. Man is the archetypal vertebrate animal.

Wyman regards limb-bones as tegumentary in origin in embryonic development.

There are four segments in the skull of vertebrates. In the fish they are proportionately larger and divided in more pieces—much head with little brain. They have premaxillary bones, we not. They do not always have teeth on the maxillary bones;

some even in the throat. Sword fish - saw-fish -. Their vertebrae are biconcave. Instead of limbs, four fins in pairs, - pectoral, ventral. The head is large to overcome resistance of the water - grows ever - brain does not grow - mouth not only opens and shuts, but jaws protruded and retracted upon each other - Swallowing, breathing - gill-covers = opercula. Fishes have been called arrested tadpoles - this is not correct in any sense. They have a larger hyoid bone and it is more important than ours - the whole form is more compact - in tail, the process-es bend down and grow thinner - no basin near the tail (or pelvis) - the pectoral fin is slightly revolved when moved - it is the propel-ler, as also the tail - sometimes the fins are separated into many finger like parts having nerves like feelers. some fishes leap - one kind climbs trees after insects (in S. A.) - in flying fish the fins are spread out and prolonged - The ventral fins are to keep the body in position or balance.

XIII.

In most fishes the connection between the spine and the skull is made by a single ~~two~~ condyle — (a condyle is a process to connect one bone with another, a general term) but some have two, as we do. — The Batrachians have two, also — but have no ribs — the haemapophyses not present in the abdomen, tho' they are in the tail.

The scapular arch belongs to the head in the fish, but in batrachians it is separate as in us.

In fish there are spines above and below — dermo-neural and dermo-haemal, for supports to skin, fins, tail, &c — batrachians have them not.

The lepidosiren, most like reptiles, have them (they are found in Africa, and have limbs.) There are amphibian reptiles that do not have limbs developed, as the syren in the marshes. The digits never exceed five in air or lung breathing animals — the farther complexity that sometimes occurs is not multiplication but variation of the five. All batrachians have at first a fish like form. Some

unlike frogs and toads have gills all thro' life, and are called perennibranchiae. All acquire lungs, even when they retain gills - so they are above fishes. Their tails and fins do not "drop off" as sometimes said, but are absorbed - in those that keep gills, the tail is retained and they become ossified. Batrachia have rudimentary ribs (pleuropophyses). There are some in warm climates (the celeciliae) that have the form of serpents. Serpents (Ophidia) have one condyle - jaws, like those of the fish, have much motion, all the pieces being so connected as to separate from each other - Boa constrictor has, as it were, six jaws. In poisonous serpents the superior maxillary bones are supported by lachrimal bones - very small in us and called unguial - None have more than two fangs, some but one; each of these has a tube with a gland at its base - the poison is pressed out by muscular action. The connection of their vertebrae is by ball and socket joints (in fish hourglass

or biconcave arrangement) – the socket is on the anterior part of the centrum, and the ball projects from the posterior part of the centrum following. They have no breast bone – plenty of ribs – no sacrum – no scapular arch – no limbs, except two slender rudimentary ones behind. Some have regarded the serpents as degraded from a higher type; but Owen does not admit this. It out-climbs the monkey, out-leaps the jerboa, out-swims the fish, catches birds on the wing, lifts up its food to eat it, &c, &c, – two hundred vertebrae and upwards, – all joints fashioned to sustain vertical pressure – they will twist only side wise unless broken or dislocated – bones of the skull several overlapping each other in a strong and elastic manner. They are fitted for their position as much as the eel, or the centipede.

XIV.

There is a gradual progress in passing from ophidian to lacertian forms. Those ophidians which have fixed jaws (less moveable i.e.) more nearly resemble the lizards. Snake-lizards, is a term applied to one family. One kind of lizard flies - its wings pend from prolonged ribs, and not the legs, as those of the flying squirrel - some little ones in Asia that suggested "dragons" to the ancients.

Crocodiles have two bones to support the head - the first called the atlas, because the head turns on it - the second, the axis. They differ in the number and arrangement of their bones. Cuvier thought they held a kind of intermediate place between Mammals, birds and fishes. Their forms are fitted for amphibious life, but they are most at home in the water - short limbs prevent movement on the land in rapidity - the over-lapping of the ribs of the neck make progress in

diaphragm

water easier, but prevent their turning quickly on land. The turtles and tortoises have portable dwelling — a modification of the vertebrate skeleton — carapace and plastron, roof and floor, is all some have — The marine are called Chelonians; freshwater, Emydians; land, Testudinians; mud, trionyx. In salt or pond horny plates. Only vertebrae in these are in the neck and tail. Whole skeleton of those in the water is lighter, and the head larger. Carapace generally of 8 pieces — in centre row of one series symmetrical in middle, and two of unsymmetrical ~~for~~ the sides. Plastrum of nine pieces — Owen says this is all from varied back-bone. Of land ones the head can be drawn in — The limbs are very prone — the humerus is bent almost into the shape of an S — there are two carpuses, one of 4 bones, the other of 5. The femur is much bent too, and shorter. In our tarsus there are seven bones; in tortoises a row of two bones and then five, of which one is incom-

-plete. Of those in the sea the limbs are flatten-
-ed. In all the bones are solid.

There is not an abrupt transition to birds. Aquatic birds, like penguins, have flat feet like the reptiles — all lay eggs like tortoise & have toothless hornlike bills — all differ in having warm blood. All their bones are hard and of ivory whiteness — bones of the limbs re-
-ceive air thro' the nasal organs. Nearly all the lines of junction in skull bones are obliterated — those few which disappear in us, are left in birds — their upper jaw moves. There is a general tendency to coales-
-cence in the bones. In most birds of flight the centrum is united to the upper arch — and several vertebrae are joined in one bone — breast greatly developed — ossification of the tendons of some of the muscles — scapula long and slender — there is a bone called the coracoid, which is in us only a process, — the clavicle joins its fellow and the sternum and the coracoid, for

strength. There is in the pelvis no union of the two halves, as in the human—advantage that it yields readily for the hard shell of the egg. The humerus is light but strong—the keel of the sternum is hollowed for lightness and the wind-pipe bends into it. In the wild swan there are 28 vertebrae, of which 23 are in the neck. In all mammals, giraffe or whale or any other, there are 7 vertebrae in the neck; this has but two exceptions, the sloth and manitus. The neck of the swan bends both in and out. The breadth of sternum relates to the power of flight. There is most variety in flying powers in the swimming birds—they have a keel for the same use as a boat does—

Bones of the wing are not so much developed as might appear—the wings depend on quills which have nothing to do with a skeleton, but are epidermoid like teeth and nails. The scapula is long and flat—

some flyers have it to the farthest rib.
There is a small bone in birds of prey between clavicle and coracoid — Humerus is short in some — not always proportioned to the flying power — the ulna is always stronger than the radius — both are long and slender — the bones of the hand are long and slender — fixed in a state of pronation — make no flexes as ours — fingers 3 less and of different use — The large quill feathers are called primaries and attached to the ulna; secondaries, to the humerus; scapularies, to the scapula — others are spinous — In the pelvis (we have in infancy three bones on each side) ~~three~~ bones, at first, but grow into one on each side — not connected in front. The femur is straight — has two condyles, and unites with both tibia and fibula. There is a ridge on the lower part that stretches a ligament making a spring joint. The spur is from the skin — most birds have four toes — ostrich has two. The parts of the toe differ in number, sometimes there are five, sometimes two.

Entire form has special reference to flight. The trunk is oval, large end forward; the spine is long and firm, in the neck very flexible. Centre of gravity comes under the wings. Birds of prey take a horizontal position; woodpeckers an oblique. — Prospects and difficulties for flying machines —

XV.

Skeletons of mammals vary greatly, for adaptation to varios conditions of life, in water as whale, amphibious as seal, subterraneous as mole, in air as bat, &c — Limbs vary most of all the parts. In marine mammals they are much like fins. In ungulata the one or more digits have all the regular joints, but they are encased in the hoof. In unguiculata the limbs are larger; toes are free, and armed with claws; these are confined to the upper surface. In the mole the bones of the arm are large and strong, as also the hand; the posterior limbs are quite slender. No animal has so powerful limbs in proportion as the mole.

In man the posterior limbs take all the locomotion. All mammals have two condyles, but so have the batrachia. Whales have more than three joints to the fingers - all others three. In whale there is no twisting of the neck. In some sea animals the seven bones of the tarsus are all in one. All mammals have ribs. The first rib in the whale is very broad and joins the sternum; the others do not. The segments of back bone in hinder part are are very strong; there is no sacrum. The course of the whale is modified by the pectoral limbs, as fishes by fins - the digits make a kind of paddle. The highest part of the skull is taken by the blow holes - the mouth full of plates. The dugong, manati, &c have the jaws bent down in front. The mammary glands of the dugong are on the breast, and the fore limbs, tho' clumsy arms, are so accommodated as to hold the young up to nurse, as a woman; this at a distance might suggest mermaids.

Seals have hind limbs while whales have not.

They have something of a hand; the hind limbs bend backward; all the bones are represented in them. The walrus has power of supporting itself up from the ground. In the walrus & seal the digits are bound together by a web of skin. The contrast between seal and horse very great—in the latter limbs remarkable—best time four miles in 6½ minutes. Space between teeth Owen thinks made expressly for the bit. Has fifty three vertebrae; eight pairs of ribs,—the ulna and radius are confluent. The 2d & 4th metacarpal bones are consolidated in the canon bone; the middle finger forms the foot, whence they are called solipedes. The tibia is the chief bone of the hind leg; are we still with three phalanges. Of all other mammals, the rhinoceros has greatest similarity to the horse, considerably more than the camel has. There are bones of extinct species of horses, in which there were ~~two~~ and even three toes (mentioned in Owen's last book). The transition between horse rhinoceros &, which seems abrupt, is thus gradually traced.

The rhinoceros has 3 toes – enormous strength. Owen make the distinction

Artiodactyle & Perissodactyle — even toed beasts & odd toed beasts.

No food more removed from flesh than grass. All hoofed animals are herbivorous; teeth, limbs, neck, &c, all adapted. The ox, hog, hippopotamus, are artiodactyle.

There is no clavicle in any ungulata, nor power of rotating fore limb, as we. In the ox there are two rudimentary hoofs above the others; in hog the same, almost on a level, and in hippopotamus, these are on the same level and nearly equal with the others.

The giraffe has 56 vertebrae, camel 48, man 24 (or 29 at largest statement).

Next, see Owen on Skeleton & Teeth – & Huxley on Man's Place in Nature

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Amer. Year Book & Cases of Facts —

Agassiz on Species —

Agassiz on the Definition of Species. (1)

(Revue des Cours Scientifiques,
13 Fevrier 1869)

"Pour peu qu'on tienne à n'exclure de la définition aucun trait essentiel et à n'y rien faire entrer qui n'ait cette qualité, il importe de reconnaitre tout d'abord qu'un des caractères de l'espece est d'appartenir à une période donnée de l'histoire du globe et d'être dans des rapports définis avec les conditions physiques alors prédominantes, ainsi qu'avec les animaux et les végétaux contemporains. Ces rapports sont nombreux et se montrent: 1° dans la portée géographique naturelle à chaque espèce, aussi bien que dans son aptitude à s'acclimater dans les contrées où elle ne se rencontrait pas primitivement; 2° dans les relations qu'elle entretient avec les éléments ambiants, suivant qu'elle habite l'eau ou la terre, les mers profondes, less ruisseaux, &c, &c, &c s'!
^ 25 items

2

3° dans la dépendance où elle est de
tel ou tel aliment pour subsister;
4° dans la durée de la vie; 5°
dans le mode d'association des indivi-
-dus qui vivent en troupes, en petites so-
-ciétés ou isolement; 6° dans la durée et le retour de la période de reproduction; 7° dans les change-
-ments subis par les individus durant
l'accroissement, et la périodicité de
ces changements pendant la métamorphose;
8° dans le mode d'association de ses
représentants avec les autres êtres, mode
qui est plus ou moins intime et consti-
-tue chez quelques-uns une association
constante, et chez d'autres le parasi-
-tisme; 9° dans toutes les particulari-
-tés, vraiment spécifiques, qui resultent
de la stature definitive, des proportions
des parties, de l'ornementation, &c,
et de toutes les variations auxquelles
l'individu peut se prêter."

(2)

The tibia is ~~the~~ chief bone of the
hind leg - one toe still with three
phalanges - of all others the
rhinoceros has greatest similarity
to horse - more than the camel is -
There were extinct horses in which
were 2 and even 3 toes (mentioned
in Owen's last book) the transition
between Rhi & horse is traced in
fossil ~~to...~~ specimens -
Rhi has 3 toes - enormous strength
Owen makes distinction -
artiodactyle, even toed beasts
perissodactyle, ~~odd~~ toed quadru-
No food more remote from flesh
than grass - all hoofed animals
are herbivorous - teeth, lips,
neck all adapted -
Ox hog hippopotamus are
all artiodactyle - No clavicle
in any Ungulata - no power
of rotating fore limb as we -
in ox two rudimentary hoofs
in hog almost on level with others
in hipp almost equal ~~large as the~~ -
~~No~~ Giraffe has 50 vertebrae

48 in camel 24 (or 2 gat larger) ~~in the animal~~ length of forelimb in Camel, one in lengthening the two middle fingers - neck very long, very flexible - no trace of the 1st 2 & 5th toes in hinder extremity - have no horns - ~~All other~~
~~shown is)~~ Antlers not horns - a bony base with sheath of horn
Amount of renewal in the fossil deer of Ireland was enormous yet grew every year -

XVI.

Difference between even and odd hoof as regards the stomach more complex in even Hippo & peccary - the removal from pentadactyle first of the inner or little finger disappears, then the thumb, fore finger, the next little finger, and middle fing is left in the horse - transition from hoofed to cleaved animals seems now very abrupt, but in geological species was gradual -
Sloth now helpless on level ground but not a monstrosity or failure

(3)

very agile on trees, always with back down - fore limbs much elongated humerus very long - longer arms than the apes - radius and ulna differ from horse by being distinct and rotating - hand attached to radius as in us - last phalanx of each toe is changed for a long strong claw - toes correspond to 2 3 4 of human foot - has no teeth in anterior part of jaws - none on premaxillary -

In anteater the skull is modified to make a sheath for the long tongue - fore limbs very strong, not spread out -

Mole adapted for subterranean -

Have 7 vertebrae in neck, but it is short and strong - There is a clavicle, but short and broad - not long and slender but almost like a cube - humerus almost as broad as long - two rows of bones in wrist of 5 in each row - we have 4 in each row - phalanx is short & very strong - Among insects the mole cricket has same arrangement for digging - Bat has teeth, viviparous - not very long but somewhat flexible - wing even more completely adapted

to its use than that of the bird —
Lion the type of quadrupeds
skull adapted for carnivorous
living by large strong bones and
muscles — high processes, and
great cavities (take the fossa in
our own temples — powerful
muscles about the neck to shake
it — in the cranium (what is a
membrane) is a bone between the
two parts of brain (cerebrum & cerebellum) — bones compact — 53 vertebrae — clavicles
not as firmly attached as we
might have expected — humerus
is perforated at the main artery
runs thro it instead of beside it
so as to be protected from pressure
of the muscles — is a thumb (or pollex)
on the fore foot — Kangaroo is
adapted in skeleton herbivorous —
marsupial — (Australia is
subject to drought —) the unguiculate
extremity is not fitted for a
grazing — but the locomotive
power is delegated to hinder
limbs and tail (leaps 20 ft —)
and the forelimbs for marsupial fun-

(4)

poses – Opossum of america has thumb on hind feet only – 20 to 30 yrds kangaroo to a bound says Owen – 50 vertebrae – bones of tail large and strong – Sloths diet foliage – Quadrumana have five digits and a thumb opposable to the fingers – (a hand is anything that has one digit opposable to the others) They approach in skull and brain to man – Owen has maintained that the cerebrum does not project over the cerebellum – but Huxley has shown it true – but the brain is not but ~~a trd~~ about half as large –

In spider monkeys no thumb – in true apes, no tail, more than we – have an intermaxillary bone – gorilla has 13 ribs – in some monkeys same number of teeth as man – Huxley

says that difs between races of men are as great as betw ape and lowest man in anatomical powers — Huxley believes in the unity of the human species — —

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Huxley Ess. On Man's Place in Nature —

Orang & Sibbon in E. Asia washes baby's face not over 5 ft high shorter —

Chimpanzee affectionate to young & child nests
Gorilla 5 ft W. Africa
big spec 170 lbs — Brigham Young —

In considering this question we should look up first and then down (Huxley only looks down) — the beginning of the answer to what is man's place in creation to be found in Gen. then in N. T. — Then we may with clear minds consider how we shall answer anatomically —

Man's lowest capacity of skull is 62, highest of gorilla 30 —